Small Business Innovation Research/Small Business Tech Transfer

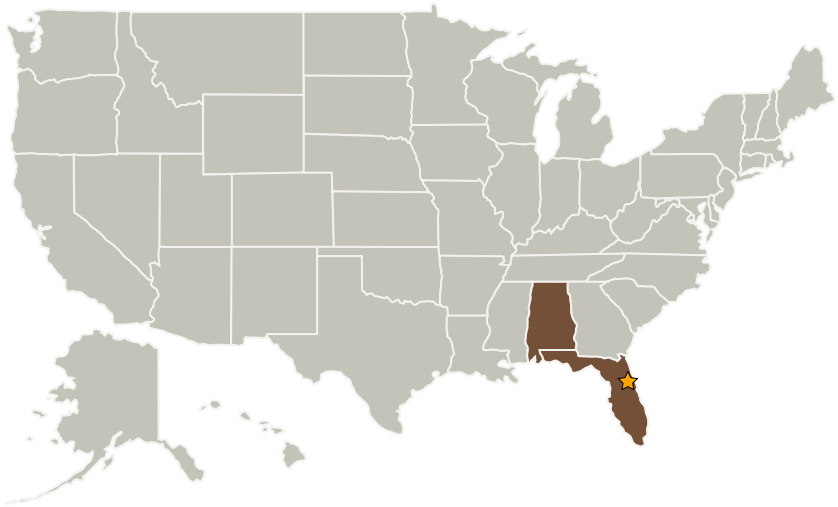
High-Fidelity Gas and Granular Flow Physics Models for Rocket Exhaust Interaction with Lunar Soil, Phase I

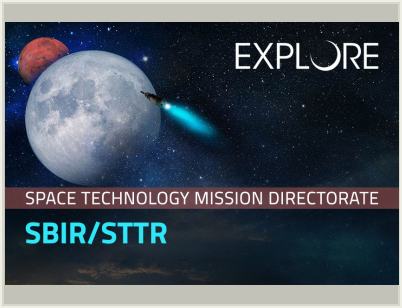
Completed Technology Project (2009 - 2010)

Project Introduction

Soil debris liberated by spacecraft landing on the lunar surface may damage and contaminate surrounding spacecraft and habitat structures. Current numerical simulations of these events lack credibility because lunar environment complexities have never been captured in suitable models: the mixed rarefied-continuum nature of the plume's surface layer flow, and the highly irregular soil particle shapes with peculiar granular stresses, particle aerodynamics, and particle collision characteristics. CFDRC and the University of Florida (UF) propose to apply their uniquely capable simulations simulation tools to derive credible lunar gas and granular flow physics sub-models from first principles. CFDRC's unified continuum-rarefied flow solver will be applied to characterize the surface layer flow structure and assess interference effects from surface craters and rocks. The code's unique ability to resolve highly irregular shapes with an automated adaptive Cartesian approach will be applied to compute realistic particle aerodynamics. A Lagrangian particle collision model developed for efficiently simulating dense particle streams will characterize particle collision and dispersion effects. A novel fundamental soil model developed by UF to describe all constituent stresses in a single fundamental model for arbitrary particle shapes mixtures will be applied. Phase I will demonstrate the unique capabilities of the proposed simulation tools. During Phase II, these tools will be applied to create high fidelity physics sub-models for integration in current erosion simulation models.

Primary U.S. Work Locations and Key Partners





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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
CFD Research Corporation	Supporting Organization	Industry	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Florida

Project Transitions

January 2009: Project Start

January 2010: Closed out

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Peter A Liever

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.5 Modeling and Simulation for EDL